ENERGY

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USSR Report

ENERGY

(FOUO 23/80)

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[redacted]

ENERGY CONSERVATION

USSR GOSPLAN APPROVES PRINCIPLES FOR FIXING RATES OF ENERGY USE

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 7, Jul 80 pp 54-59

[Basic Principles for Fixing Rates of Consumption of Fuel and Thermal and Electric Power in the Economy, Approved by Resolution of the USSR State Planning Committee of 17 December 1979, No 199]

[Text] The basic principles for fixing rates of consumption of fuel and thermal and electric power in the economy contain systematic organizational bases for establishing the consumption rates of these resources as well as the classification and composition of these rates, the methods of devising them and the procedure for their approval.

These principles are intended for management in the development of procedures and instructions as well as for the solution to procedural and organizational questions concerning the rates of consumption of fuel and power resources and the production and operational needs of industry, construction, transport and rural and municipal economies at all levels of planning.

These basic principles are being introduced in place of the Basic Principles for Fixing Rates of Consumption of Fuel and Thermal and Electric Power in Industry, approved by the USSR State Planning Committee, 1 April 1966.

The basic principles were prepared by USSR State Planning Committee experts N. A. Vasin, E. I. Vertel', G. A. Lobanov, B. V. Mikhaylov, A. M. Nekrasov, G. M. Pokarayev, A. Kh. Sal'nikov, P. V. Sventitskiy, I. A. Shadrukhin and staff members of the Scientific Research Institute of Planning and Standardization attached to the USSR State Planning Committee M. M. Runtso and L. A. Shevchenko.

1. General Principles

1.1. Fixing rates of consumption for fuel and thermal and electric power means determining their planned degree of expenditure.

1.2. The primary goal of rate fixing is to insure that technically and economically based progressive standards for the consumption of fuel and thermal and electric power during planning and in production are applied in order to conserve these resources, distribute them efficiently and utilize them most effectively.

1.3. The establishment of rates of consumption for fuel and thermal and electric power is accomplished at all levels of planning and economic activity in accordance with the Systematic Instructions for the Formation of State Plans for the Economic and Social Development of the USSR, the current Basic Principles and the specialized procedures and instructions that correspond to these documents.

All expenditures of fuel and thermal and electric power on primary and secondary industrial and operational needs (heating, ventilation, lighting, water supply, etc.) are subject to rate fixing, including network losses, regardless of the extent of the demand for the resources indicated or the sources of the power.

1.4. Fixed rates of consumption for fuel and thermal and electric power are planned indicators of the expenditure of these resources per unit of production (or work) of a specified quality.

1.5. The fixed rates of consumption of fuel and power resources are formulated separately for furnace fuel oil at a nominal rate, for diesel fuel[1] and for thermal and electric power. In addition to the fixed rates of consumption for fuel and thermal and electric power, fixed rates of consumption for compressed air, oxygen and water for the production of goods and services are also established in enterprises.

Generalized unit energy expenditures (design, plan and actual) are determined for the overall appraisal of the effectiveness of utilization of fuel and power resources in the production of single-type or interchangeable goods (or work). These include the expenditure of all types of fuel and power in the production of goods and services, converted into units of conventional fuel. In this case, the unit energy expenditures are determined on the basis of the corresponding unit expenditures of fuel and thermal and electric power for the production of goods and services and the standard fuel equivalents of thermal and electric power.

1.6. Fixed rates of consumption of fuel and thermal and electric power are used to plan the expenditure of these resources and their efficiency of utilization. The implementation of the established rates is a necessary condition for economic stimulation to conserve fuel and power resources.

1.7. Fixed rates of consumption for fuel and thermal and electric power must:

-be developed at all levels of planning on a single systematic basis for the entire range of products and types of services in accordance with the sort of organization cited above;

-take into consideration the manufacturing conditions, the achievements of scientific and technical progress and the plans associated with organizational and technical measures which provide for the efficient and effective utilization of fuel and thermal and electric power;

[1]In these Basic Principles the general term "fuel" is used for both furnace fuel oil and diesel fuel.

- be systematically reviewed with consideration being given to the planned development and technical progress of manufacturing and to the most efficient indicators for the utilization of fuel and power resources that are obtained;

- contribute to the maximum mobilization of internal resources, to the conservation of fuel and thermal and electric power, to the accomplishment of planned tasks and to the achievement of good economic results in production.

2. Classification of the Fixed Rates of Consumption

2.1. The fixed rates of consumption of fuel and thermal and electric power in manufacturing are classified according to the following basic criteria:

- according to the degree of aggregation--individual or group;

- according to the composition of the expenditures--production or general industrial;

- according to the operational period--yearly or quarterly (monthly rates may also be established at enterprises).

2.2. The individual fixed rate of consumption is that rate of consumption of fuel and thermal and electric power for the production of a single item (or work), established according to types of fuel and power consuming units, installations, machines (steam and boiler, furnace, vehicle, aircraft, etc.) and the production layout associated with specific conditions in the production of goods (or work). The rates may also pertain to individual units, installations, machines and production layouts.

2.3. The group rate is that fixed rate of consumption of fuel and thermal and electric power for the production of a planned volume of univariate goods (or work) in accordance with the established product list at different planning levels--national economy, ministry (or department), union republic, association and enterprise.

2.4. The production rate is that fixed rate of consumption of fuel and thermal and electric power which takes into account the expenditure of these resources on primary and secondary production processes in the production of a given type of goods (or work), the expenditure on maintenance of production machinery in the hot reserve, on heating up this equipment and restarting it after scheduled maintenance and cold downtime, and on the technically unavoidable energy losses during the operation of this equipment.

In planning rates of fuel consumption, only the production rates of consumption for the production of goods (or work) are established.

2.5. The general industrial rate is that planned rate of consumption of fuel and thermal and electric power which takes into account the expenditure of power on the primary and secondary production processes and the secondary needs of industry (the general industrial, shop and plant requirements for heating, ventilation, lighting, etc.) as well as the expenditure for technically unavoidable energy losses in transformers and thermal and electric networks of enterprises (shops) during the production of given goods (or work).

3. Composition of Fixed Rates of Consumption

3.1. The composition of the fixed rates of consumption for fuel and thermal and electric power is a list of items of expenditure which are taken into account in the fixed rates for the production of goods (or work). This list is determined in accordance with special procedures and regulations which have been developed with regard to particular characteristics in the production of the goods (or work). On the basis of these special procedures and regulations, the specific composition of the fixed rates of consumption is determined at each enterprise.

A model composition of fixed rates of consumption for fuel and thermal and electric power for industrial enterprises is attached.

3.2. At enterprises manufacturing similar or diverse products according to various production layouts or on different types of equipment, it is expedient when calculating the fixed rates of consumption to allocate the general industrial shop and plant expenditures of fuel and thermal and electric power for the production of goods and work in a manner that is proportional to the consumption of power in the production processes or in a manner that depends upon the extent of services obtained from the auxiliary or subsidiary shops, namely:

a) for transportation shops--proportional to the volume of transported freight;

b) for tooling, maintenance and other auxiliary shops--proportional to the share of services provided;

c) for compressing, pumping and other shops or power plants--proportional to the volume of air, gas, oxygen, water, etc. obtained from them;

d) for central plant laboratories--proprtional to the amount of analysis and the volume of testing carried out in connection with the manufacture of a given type of product.

The energy losses in thermal and electric networks and transformers are determined on the basis of experimental measurements or are proportional to the consumption of power for the production of the corresponding types of goods (or work). The procedure for distributing the losses is determined by special methods and instructions.

3.3. Fixed rates of consumption of thermal and electric power for heating, ventilation, refigeration, the production of compressed air and oxygen, water supply and other secondary needs of industry must be established separately at enterprises and (according to the determination of ministries and departments) associations as well.

3.4. The losses of fuel and thermal and electric power caused by variations in accepted production technology, operating conditions and formulas and by nonobservance of the requirements for raw materials and stocks as well as other inefficient losses need not be included in the fixed rates of consumption for these resources.

3.5. Fixed rates of consumption for fuel and thermal and electric power in the production of goods (or work) do not include expenditures for the construction and major repair of buildings and structures, for the installation, start-up and adjustment of new production equipment, for scientific research and experimental operations, for outside power distribution (for settlements, dining facilities, clubs, day nurseries and kindergartens, etc.) and for fuel lost in storage and while being transported. The rates of consumption of fuel and thermal and electric power for these needs must be established separately.

If, in addition to the main product, an enterprise produces semifinished goods which are supplied to other enterprises (castings, forgings, stampings, clinker brick, etc.) or goods for public consumption, the expenditure of fuel and thermal and electric power on their manufacture is fixed separately and is not included in the fixed rates of consumption for the manufacture of the main product (work).

4. Units of Measurement for Fixed Rates of Consumption

4.1. The units of measurement for fixed rates of consumption must correspond to the units of measurement used for the planning and accounting of fuel and thermal and electric power and the volume of production items (or work). They must also insure the practical feasibility of monitoring the realization of these rates.

4.2. The rates of consumption of fuel and thermal and electric power per unit of production (or work) are fixed:

- for furnace fuel oil--in kilograms and grams (kg, g) of conventional fuel;

- for thermal power--in gigacalories and thousands of kilocalories (Gcal, kcal);

- electric power--in kilowatt hours (kWh);

- for gasoline, diesel fuel, jet fuel and other petroleum products--in kilograms and grams (kg, g) of natural or conventional fuel.

4.3. The fixed rates of consumption for fuel and thermal and electric power are established for the manufacture of one unit of the finished product (a ton of pig iron, a ton of coal), for a unit of processed raw material (a ton of refined oil) or for a unit of work performed (a ton-kilometer, a running meter of penetration, etc.).

4.4. When fixing rates of consumption for fuel and thermal and electric power for the production of a single type of article (or type of work) that varies in composition (or consists of different types of work carried out), conventional units of measurement are employed (canned goods--in standard cans; mechanized cultivation--in standard hectares, etc.).

4.5. In the machine construction sectors of industry which manufacture products according to an extensive product list, the fixed rates of consumption of thermal and electric power are set, in exception to the rule, per 1000 rubles of net (standard) or commercial production. For construction, the rates are set per 1000 rubles of construction and installation work performed using local resources. This procedure is followed in the construction industry and in repair and experimental plants at the ministry and departmental level, where it is practically impossible to select a single unit of measurement for production in real or conventional units. It is also followed in associations and enterprises for which production plans are approved in terms of cost.

The fixed rates of consumption indicated must be determined according to the appropriate procedures and instructions, taking into account the planned measures for energy conservation. At the same time, fixed rates of consumption for thermal and electric power for the manufacture of a unit of production or for the accomplishment of a physical amount of work, expressed in real units, must be established for power-consuming processes (founding, forging, heat-treating, arc welding, compression of air and oxygen, heating, ventilation, etc.).

5. Methods for Developing Fixed Rates of Consumption

5.1. A computed analytical method is primarily used to develop fixed rates of consumption for fuel and thermal and electric power. In addition, empirical and computed statistical methods are also employed.

Computed analytical and computed statistical methods are primarily used to determine group fixed rates of consumption for fuel and thermal and electric power.

5.2. The computed analytical method provides for determining the fixed rates of consumption of fuel and thermal and electric power by an estimated method. The rates are determined according to item expenditures, using progressive indicators for the consumption of these resources in production.

Group fixed rates of consumption for fuel and thermal and electric power are determined, as a rule, by means of the calculated analytical method. The rates are determined as weighted average values, using the individual fixed rates of consumption and the corresponding volumes of production. In individual cases, the group fixed rates of consumption for the planned year can also be determined on the basis of the corresponding rates from the base year, taking into account the progressive indicators of specific consumption that are achieved and the planned organizational and technical measures that are taken to conserve fuel and power.

The individual fixed rates of consumption are determined on the basis of theoretical calculations and experimentally established rated performance characteristics[2] of power-intensive units and installations, taking into account the progressive indicators of specific consumption of fuel and thermal and electric power that are achieved and the measures for conserving these resources that are introduced.

In order to provide for the development of fixed rates of consumption, it is necessary to:

- adjust the time periods established by the organizations mentioned above. After measures have been taken for production improvements associated with changes in equipment parameters and processes, power trials of the equipment must be conducted. According to the data from these trials, the corresponding power balances and rated performance figures for the type of equipment, installation or unit can be established;

[2]Henceforth the term "rated performance characteristic" will be used to describe the dependence of the specific consumption of fuel and thermal and electric power on the load (productivity) of the equipment and upon other factors under normal operating conditions.

- carry out systematic monitoring, accounting and analysis of the specific operational consumption figures for fuel and thermal and electric power and eliminate inefficient expenditures of fuel and power.

In order to appraise the accuracy of the calculation of the fixed rate for the system being used, it is necessary to carry out identical calculations for a year for which current data are available and then consider the results when determining the fixed rates of consumption of fuel and thermal and electric power for the period being planned.

5.3. The empirical method for developing individual fixed rates of consumption consists of determining the specific expenditures of fuel and thermal and electric power according to data obtained as a result of testing (experiments). In this case, the equipment must be adjusted and in proper operating condition. The production process must be carried out under conditions specified by production regulations or instructions.

5.4. In those cases when it is not possible to use the calculated analytical and empirical methods to determine the fixed rates of consumption, the calculated statistical method of establishing the fixed rates of consumption can, as an exception, be employed. This method is based upon an analysis of the statistical data from a number of preceding years concerning the actual specific consumption of fuel and thermal and electric power as well as upon other factors causing variation in the data.

5.5. The basic reference data for determining the fixed rates of consumption of fuel and thermal and electric power are:

- original technical and engineering documentation;

- production regulations and instructions, experimentally checked power balances and rated performance characteristics of the power and production equipment, raw materials, technical certificates for the equipment, standardized indicators which describe the most efficient and effective manufacturing conditions (the power factor, the rates of consumption for the power carriers in production, the specific thermal characteristics for calculating heating and ventilation expenditures, the rates of energy loss during transmission and transformation and other indicators);

- data on the volume and structure of the production of goods (or work);

- data on planned and actual specific rates of consumption of fuel and power for previous years as well as documentation verifying the utilization of these data in production;

- data from domestic and foreign enterprises engaged in the manufacture of similar products regarding their advanced experience in the economical and efficient utilization of fuel and power and the specific rates of consumption that have been achieved.

- a plan for organizational and technical measures to conserve fuel and power.

6. Procedure for Establishing a Plan of Organizational and Technical Conservation Measures, of Fixed Rates of Consumption and of Programs for the Mean Reduction of These Rates

6.1. Organizational and technical measures for the conservation of fuel and thermal and electric power are developed at all administrative levels and are arranged according to the following basic guidelines as applied to the production of goods (or work) in agreement with the established product list:

- the further development of production technology;

- an improvement in the utilization and structure of industrial equipment;

- an increase in the quality of raw materials and the use of types of raw materials that are less energy-consuming;

- and other measures (organizational, economic, etc.).

6.2. The reference data for the development of plans for organizational and technical measures to conserve fuel and thermal and electric power in industry are:

- a comprehensive 20-year program for scientific and technical progress;

- a specific overall scientific and technical program to conserve fuel and power resources;

- basic guidelines for the economic and social development of the USSR over the next 10 years (in five-year increments);

- programs for a mean reduction in the fixed rates of expenditure of fuel and thermal and electric power established by the organizations listed above for the planned period;

- programs for the solution of special scientific and technical problems and for the overall utilization of natural resources;

- proposals for the utilization of the achievements of scientific and technical progress and the results of completed scientific research and planning and design studies in the economy;

- standards for the machines and equipment;

- results from an analysis of the utilization of fuel and thermal and electric power in industry in previous years;

- power balances at the enterprises;

- efficiency proposals, as well as the results of work on conserving fuel and power resources that have been achieved by leading enterprises, shops and work crews.

During the development of organizational and technical measures to conserve fuel and thermal and electric power, it is necessary to appraise the economic effectiveness of these measures in an effort to select the best method and determine its expediency, as well as to establish the order in which these measures are to be introduced into industry.

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6.3. Requirements for the mean reduction of the fixed rates of consumption of fuel and thermal and electric power in industry are established within the plans of economic and social development of the USSR for the ministries and departments of the USSR and the councils of ministers of the union republics. These requirements are drawn up for the planned period (for each year of the five-year plan and the following planned year). The requirement for the mean reduction in the fixed rates is expressed as a cumulative percentage rate adjusted to the level of the actual specific rates of consumption of the base year for the corresponding types of fuel and power resources. The last year preceding the planned period is used as the base year.

In the absence of accounting data regarding the actual specific rates of consumption, the requirements for the mean reduction in the fixed rates of consumption are expressed in percentages adjusted to the level of fixed rates for the base year.

At the same time, the ministries and departments of the USSR and the councils of ministers of the union republics calculate the amount of the mean reduction in the fixed rates of consumption for each year of the five-year period in percentages adjusted to the rate level of the previous year.

In order to determine the planned requirements for the mean reduction of the fixed rates of consumption for fuel and thermal and electric power, the fixed rates for the planned year are used. In addition, the actual specific rates of consumption or the fixed rates of consumption for the base year, the corresponding volumes of production for the planned year and the organizational and technical measures for the conservation of fuel and thermal and electric power are also employed.

6.4. When developing a plan for the basic guidelines for the economic and social development of the USSR over the next 10 years (in five-year increments), the ministries and departments of the USSR and the councils of ministers of the union republics submit to the USSR State Planning Committee their preliminary drafts of plans for organizational and technical measures to conserve fuel and thermal and electric power (along economic lines), drafts of basic rates of consumption (according to the established product list) and proposals for the mean reduction of the fixed rates of consumption according to the procedure and the time periods established by the directive agencies and the USSR State Planning Committee (for the first five-year period--per one-year increment; for the second five-year period--per five-year increment).

The USSR State Planning Committee examines the proposals of the ministries and departments of the USSR and the councils of ministers of the union republics, establishes projected figures for the mean reduction in the fixed rates of consumption of fuel and power per year for the forthcoming five-year plan and gets them ready for the ministries and departments of the USSR and the councils of ministers of the union republics a year before the beginning of the next five-year plan. The ministries and departments of the USSR and the councils of ministers of the union republics insure that these projected figures are delivered to the associations, enterprises and organizations during the month after they are obtained from the USSR State Planning Committee.

6.5. When developing the expanded five-year plan (per each year of the five-year period), the ministries and departments of the USSR and the councils of ministers of the union republics enlist the aid of institutes, enterprises and organizations in the field and, starting with the projected figures from the USSR State Planning Committee regarding the mean reduction in the fixed rates of consumption for fuel and thermal and electric power for the five-year period and with the planned volumes of production of goods (or work), they refine their plans for organizational and technical measures and the extent of the planned savings. They develop plans for the fixed rates of consumption and requirements for the mean reduction of the fixed rates of consumption of fuel and power on a cumulative percentage basis with respect to the years of the five-year plan and submit them to the USSR State Planning Committee.

The USSR State Planning Committee reviews these proposals, specifies plans for the fixed rates of consumption in the production of the basic types of goods (or work) and the mean reduction in the fixed rates of consumption of fuel and power for the ministries and departments of the USSR and the councils of ministers of the union republics on a cumulative percentage basis with respect to the years of the five-year plan and presents a draft of the basic fixed rates of consumption and the requirements for the mean reduction in the fixed rates of consumption for fuel and power in the form of a five-year State plan for the economic and social development of the USSR to the USSR Council of Ministers.

The completion of requirements for the mean reduction of the fixed rates of consumption for fuel and power in the five-year plan is evaluated at all levels of economic administration as a cumulative sum, starting at the beginning of the five-year period.

6.6. The ministries and departments of the USSR and the State planning committees of the union republics establish procedure and bear responsibility for preparing the materials indicated in 6.4 and 6.5. They also determine the degree to which the enterprises and scientific research and design organization participate in the development of these materials.

6.7. The requirements for the mean reduction in the fixed rates of consumption and the fixed rates of consumption for fuel and thermal and electric power, which are established in the yearly plans, are developed on the basis of the requirements of the five-year plan regarding the given year. The indicated requirements and the basic fixed rates of expenditure must be specifically defined. Consideration must be given to the latest achievements of science and technology, and economic and organizational measures that insure the completion of the requirements of the five-year plan must be carried out.

The development of the requirements for the mean reduction in the fixed rates of consumption for fuel and thermal and electric power for the yearly plan begins with the production associations (enterprises) and organizations. In comparison to the corresponding fixed rates and requirements of the five-year plan for the projected year, production associations (enterprises) and organizations develop progressive indicators to conserve fuel and power resources in the forthcoming plan, based on the expansion of socialist competition and the utilization of internal economic reserves. Along with the requirements of the five-year plan, these progressive indicators are considered by the ministries and departments of the USSR and the State Planning Committees of the union republics when preparing the draft of the plan for the next year.

At all levels of planning, the indicators for the yearly plan must not be lower than the requirements of the five-year plan which have been set for that year.

6.8. The ministries and departments of the USSR and the State Planning Committees of the union republics differentiate the plan indicators (five-year and yearly) indicated in paragraphs 6.4, 6.5 and 6.7 and prepare them for the responsible associations, enterprises and organizations no later than one and a half months before the beginning of the planned period. The values of the differentiated rates and the requirements for the mean reduction of the fixed rates of consumption for fuel and thermal and electric power according to the levels of planning must be in accord with the rates and requirements established by the organizations listed above.

6.9. Within the limits of the fixed rates and requirements for the mean reduction in the fixed rates of consumption which have been established for them, the production associations (enterprises and organizations) set fixed rates of consumption for fuel and thermal and electric power that are differentiated for shops and units both yearly and quarterly.

6.10. The fixed rates of consumption may not be adjusted upwards, and the requirements for the mean reduction in the fixed rates of consumption of fuel and power may not be adjusted downwards, based only on the actual level of their realization.

7. The Organization of Fixed Rates of Consumption and the Monitoring of the Utilization of Fuel and Thermal and Electric Power

7.1. Work on the organization of fixed rates of consumption for fuel and thermal and electric power includes:

- the development of procedures and instructions for fixing rates;

- the development of the established list of products (or work) for the production of which the rates of consumption are determined;

- the development of organizational and technical measures to conserve fuel and thermal and electric power;

- the development and approval of individual and group fixed rates of consumption and the requirements for the mean reduction of the fixed rates of consumption for the planned period;

- the delivery of these fixed rates and requirements to those individuals who will implement them;

- the conduction of analysis and the provisions for monitoring the execution of the established rates of consumption for fuel and thermal and electric power, of the requirements for the mean reduction of these rates and of the planned organizational and technical measures;

- the improvement of methods to account for the implementation of the fixed rates of consumption for fuel and thermal and electric power and of the requirements for the mean reduction of these rates.

Model Composition of the Fixed Rates of Consumption for Fuel and Thermal and Electric Power for Industrial Enterprises

Types of rates, names of the items of expenditure of fuel and thermal and electric power	Types of resources		
	Fuel	Thermal power	Electric power
Production process:			
The consumption of fuel and thermal and electric power for production processes in industry, with consideration given to the expenditure needed to maintain production units in the hot reserve, for their heating-up and restarting after scheduled maintenance and cold downtime, as well as the technically unavoidable losses in the equipment used, the production units and installations.	X	X	X
General Industrial and Shop			
The consumption of thermal and electric power that forms a part of the production rate		X	X
The consumption of thermal and electric power for secondary shop needs:			
heating		X	X
ventilation		X	X
lighting			X
in-shop transport			X
maintenance shop operations		X	X
domestic and sanitation and hygiene needs (hot showers, washrooms, personal hygiene rooms for workers)		X	X
Power losses from in-shop networks and transformers		X	X
General Industrial and Plant			
The consumption of thermal and electric power that forms a part of the general industrial and shop rate		X	X

Types of rates, names of the items of expenditure of fuel and thermal and electric power	Types of resources		
	Fuel	Thermal power	Electric power
General Industrial and Plant (continued)			
The consumption of thermal and electric power for the secondary needs of the enterprise:			
production of compressed air		X	X
refrigeration		X	X
production of oxygen and nitrogen		X	X
production of producer gas		X	X
water supply		X	X
production needs of secondary and maintenance shops and services (repair, tool and other shops, plant laboratories, warehouses, administrative buildings, etc.), including their lighting, heating and ventilation		X	X
operation of in-plant transport (electric trucks, diesel shunters, cranes, pneumatic transport, rail transport)		X	X
outdoor lighting, heating of plant pipelines, intershop transport of raw materials and semifinished goods, etc.		X	X
Losses in plant thermal and electric networks and transformers up to the point where shops are accountable		X	X

7.6. In order to monitor the implementation of the fixed rates of consumption for fuel and thermal and electric power, the accounting for the expenditures of these resources in enterprises must be organized with the aid of computers, installed in compliance with their operational specifications. During the design of new enterprises or the renovation of those now operating, it is necessary for the design organizations to provide for devices to account for the consumption of fuel and thermal and electric power in the design estimate documentation.

7.7. Indicators of the specific rates of consumption of fuel and thermal and electric power as well as generalized unit power expenditures for the production of goods (or work) must be included as a technical and economic part of the designs for new and renovated industries.

7.8. It is necessary to provide for indicators of the specific rates of consumption of fuel and thermal and electric power per unit of production (or work) in the new standards for machines and equipment, along with the other qualitative characteristics.

7.9. Monitoring of the implementation of measures to conserve fuel and thermal and electric power, their fixed rates of consumption and the requirements for the mean reduction of these rates is carried out by departmental and extradepartmental monitoring organizations. This monitoring is based upon data from the original accounting figures and is accomplished by checking the status of rate fixing on the spot and by analyzing the State and departmental accounts.

7.10. When performing work associated with rate fixing and the accounting of fuel and power resource utilization, it is necessary to provide for the application of computer technology.

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ENERGY CONSERVATION

ENERGY CONSERVATION IN THE ALUMINUM INDUSTRY

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 8, Aug 80 pp 4-5

[Article by Yu. D. Zhuravin, engineer, Soyuzalyuminiy All-Union Production Association" "Ways to Conserve Fuel-Energy Resources at Enterprises of the Aluminum Industry"]

[Text] The aluminum industry is the most energy-intensive subsector of the USSR Ministry of Nonferrous metallurgy: enterprises of Soyuzalyuminiy [USSR Aluminum] All-Union Production Association consumed 27 percent of our fuel, 34 percent of our thermal energy, and 56 percent of our electricity. Such a volume of energy consumption and the requirement of continuously providing energy resources for industrial processes inspire heightened attention in the subsector to questions of reliable energy supply and efficient use of fuel-energy resources. As much as 95 percent of the energy consumed goes for the technological load of the plants, so unplanned limitations on, to say nothing of interruptions in, energy supply cause, in addition to a reduction in production of output, disruption of the technological process which leads to a decrease in the quality of the metal, a substantial worsening of working conditions, and overexpenditure of raw materials and electricity.

The production of alumina and aluminum involves the consumption of large volumes of such fuel-energy resources as steam, compressed gas, natural gas, mazut oil, coal, and industrial water used for central heating. Central heat and electric power plants and production boilers of aluminum industry enterprises provide 45 percent of the subsector's requirement of thermal energy and 4.5 percent of its electricity requirement; the remainder of the thermal and electrical energy comes from enterprises of the USSR Ministry of Power and Electrification.

Each year enterprises of Soyuzalyuminiy work out and introduce steps to reduce the consumption of fuel-energy resources and use them efficiently. Table 1 below gives figures on conservation of fuel-energy resources in the subsector during the current five-year plan.

Table 1.

Year	Standard Fuel, tons	Thermal Energy, gcal	Electricity, kwt-hours
1976	23,500	215,000	209,300,000
1977	54,300	256,300	278,000,000
1978	32,000	355,900	733,000,000
1979	76,500	194,000	242,000,000

Table 2 shows the enterprises that achieved the best results in conserving fuel-energy resources in 1979 as compared to specific norms.

Table 2.

Enterprise	Standard Fuel, tons	Thermal Energy, gcal	Electricity, kwt-hours
Pikalevo Production Association Glinozem imeni 50-Letiya SSSR	3,400	11,800	26,000,000
Volgograd Aluminum Plant	300	1,500	7,000,000
Krasnoyarsk Aluminum Plant imeni 50-Letiy VLKSM	1,000	10,400	41,300,000
Volkhov Aluminum Plant imeni S. M. Kirov	1,800	4,000	1,800,000
Southern Ural	700	3,600	1,600,000

Through the introduction of measures the electricity consumption to produce one ton of aluminum in the subsector has decreased 718 kilowatt-hours in 12 years. The average annual increase in conservation of electricity of the production of aluminum is 0.34 percent. This is accomplished, for example, by replacing mercury rectifiers with more economical and reliable semiconducting silicon aggregates with direct current of 12.5-25 kiloamps and a voltage of 450-850 volts. Thus, in 1970 the capacity of silicon rectifiers was 52 percent of the total capacity of transformer units; in 1980 they accounted for 97 percent. The replacement of the 24 remaining mercury rectifiers with semiconductors at the Novokuznetskiy Volkhov, Dnepr imeni S. M. Kirov, Ural, and Kanaker aluminum plants will make it possible to conserve 100 million kilowatt-hours of electricity a year.

Plans for technical re-equipping of the subsector envision the following:

- adapting more than 300 S-4 and S-7 electrolyzers as type S-8M electrolyzers, which will make it possible to reduce annual electricity consumption by 28 million kilowatt-hours;

- switching the three-effect evaporation batteries at the Ural and Bogoslovskiy to a four-effect plan and introducing autoclave batteries with higher frequency of separation heating, which will make it possible to save 21,000 gigacalories of thermal energy each year;

- introducing four waste recycling boilers behind the coke firing furnaces in the anode compound shops of the Krasnoyarsk and Tadzhik aluminum plants which will provide an annual savings of 20,000 tons of standard fuel.

A significant economic impact is expected from the introduction of automated systems for control of enterprises and industrial processes at the Achinsk Aluminum Combine, the Bratsk, Krasnoyarsk, Irkutsk, Novokuznetskiy, and Dnepr aluminum plants, and the Pikalevo Glinozem [Alumina] Production Association.

Systemwide plans of steps to be taken until 1985 have been developed to give fuel-energy conservation work greater purposefulness and comprehensiveness. These plans developed by the VAMI [All-Union Institute of Aluminum and Magnesium] Institute on assignment from Soyuzalyuminiy, envision reducing electricity consumption in the production of one ton of aluminum by 1,000 kilowatt-hours, cutting thermal energy used in alumina production by 30-40 percent, and reducing boiler-furnace fuel consumed by 7-8 percent. These plans include the principal design, technological, and organizational-technical steps to reduce specific expenditures of fuel-energy resources. Most of them have gone through the stages of research and experimental industrial testing and are being introduced at aluminum and alumina plants. Some of the steps require additional research to determine the optimal hardware, circuitry, and technological concepts.

Work has been completed on correction of existing and development of new instructions on setting norms for use of fuel, electricity, and thermal energy to produce all types of output by enterprises of the subsector.

Each month Soyuzalyuminiy makes an analysis of the use of fuel-energy resources based on enterprise reports using form No 11-sn (scheduled); quarterly analyses are based on form No 11-sn. The association adjusts use norms and establishes steps to eliminate inefficient use of fuel-energy resources.

To improve the energy system, increase its working reliability, and promote the conservation of fuel-energy resources, the collectives of the enterprise energy services and subdivisions of the VAMI Institute are directing their efforts to solving the following primary problems:

- investigation and formulation of optimal fuel-energy balances for enterprises;

- introduction of efficient diagrams and equipment;
- improvement in the composition of electrolytes to increase the productivity of electrolyzers and reduce electricity consumption;
- acceleration of the development and introduction of new energy technology processes and equipment;
- improving the efficiency of energy technology and energy units;
- developing (jointly with the electrical equipment industry) more reliable and economical electrical equipment (semiconductor aggregate for 63 kiloamps and 850 volts with a primary voltage of 20-35 kilovolts for electrolytic series working on 260 kiloamp current);
- development of measuring equipment for large direct currents of 100-300 kiloamps with high (at least 0.5) precision ratings;
- development of reliable welded and assembled electrical contact couplings for busbars and bus conductors for large currents;
- use of new (for example parametric) sources of direct current to supply electrolytic series with stabilized current;
- development and introduction of thyristor drive for overhead electrical cranes, electrical trucks, and large electric motors;
- development of thermal energy by centralization of steam, water, gas, and air supply with replacement of outdated equipment;
- maximum use of secondary energy resources;
- development of devices that use low-potential heat;
- introduction of model planning concepts for automated control systems for industrial processes, enterprises, and the power system at enterprises of the subsector;
- improving the reliability and efficiency of work of automation systems (introduction of new systems, for example the Elektroliz type system).

One of the main directions of work to conserve energy resources is reducing specific electricity use in the production of aluminum and specific consumption or thermal energy and fuel in alumina production. Great importance is attached to the development of socialist competition, broad use of the press and graphic education, and work by people's control posts. In addition, steps are being taken to insure accident-free work and fulfillment of schedules for planned preventive repair of energy equipment.

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OILFIELD INJECTION WATER MUST BE COMPATIBLE WITH RESIDUAL WATER

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[Article by A. S. Rovenskaya and O. A. Chernikov (IGiRGI [Institute for the Geology and Development of Fuel Minerals]): "Prediction of the Deposition of Carbonate Salts During the Development of West Siberian Oilfields"]

[Text] The recovery of oil at West Siberian fields, as is the case in almost all oil-bearing regions, is complicated by the presence of inorganic salts. They are precipitated out on oilfield equipment during all methods of well operation. In most of the wells in the oilfields of the region being examined, it is calcium carbonate that is precipitated out.

It has been established that the carbonates precipitate out mainly during the development of productive strata when edge water flooding is used, as a result of disturbance of the carbonate equilibrium of the system when there is a change in physico-chemical and thermodynamic conditions.

The reaction of the process that occurs can be written as:

$$Ca(HCO_3)_2 \rightleftarrows CaCO_3\downarrow + CO_2 + H_2O.$$

Based upon the fact that carbonic acid exerts a considerable influence on the carbonate balance, and considering the fact that carbonic acid converts into water during the recovery of water-cut oil, it has been proposed that forecasts be made of salt deposition, based upon computations of phase equilibrium of the oil-and-water system in accordance with Yu. B. Namiot's methodology [5].

This method has not been used widely because there have not been enough fundamental studies made of the coefficients of distribution of carbon dioxide between the oil and the water, and also because of the lack of experimental data on the constituent composition of the stages of degassing of deep samples of the oily fluid.

The carbonate balance depends upon the presence of a definite concentration of carbon dioxide, but the $CaCO_3$ precipitates out from the solution only during supersaturation thereof with an ion that forms inorganic precipitate anionically or cationically.

The $CaCO_3$ precipitates when chemically incompatible waters mix in the wells, that is, when one of them has an increased carbonate-ion content and the other increased calcium. As a result, the solution is a supersaturated carbonate of calcium, and the latter precipitates out in the form of a solid sediment.

The deposition of salts in water-encroached wells is associated in most cases with the advance of injection water that is sharply different in physical and chemical characteristics from the residual water that is found in the oil-saturated strata.

The water that is produced from oil from development wells is the product of the mixing of injection water and residual water. Therefore, in order to explain the possibility of salt formation, a study of the change in carbonate saturation of the produced water obtained during development of the deposit is of paramount importance.

The water's composition is caused by the set of physical, chemical and thermodynamic factors that determine the carbonate balance of the system.

At West Siberian oilfields, water taken from the Cenomanian horizon, the Vakh River, Lake Kimyr-Emtor and the Lyuk-Kolen-Egan River is used for injection. The residual waters in the productive strata are close in composition to brine waters of the calcium-chloride and sodium-hydrocarbonate types, with mineralization of up to 30 g/liter.

The pumped (Cenomanian) water is identical to the brine water, while the fresh water (from the Vakh River and other sources) is sharply different from the brine water not only in mineralization and content of salt-forming ions but also in the increased concentration of aggressive carbonic acid (up to 74.8 mg/liter).

In the brine water of the Shaim group of fields, an increased amount of hydrocarbonate and carbonate ions has been recorded, while the latter are entirely absent in the brine waters of other fields.

In order to predict the deposition of salts, the carbonate balance of the produced waters was studied, which enabled clarification of the degree of saturation of the system during the various developmental periods. The method proposed [6] was carried out according to the Debye-Hückel theory; solubility was determined through ion activity [2], with V. M. Levchenko's correction for concentrated solutions [4].

The solubility product of calcium carbonate $a_{Ca}a_{CO_3}$ was established in accordance with the coefficients of activity of the ions (ν) and their concentrations

$$a_{Ca}a_{CO_3} = \nu_{Ca}[Ca]\nu_{CO_3}[CO_3].$$

The ion activity coefficient was determined in accordance with the Debye-Hückel equation [5 and 6].

$$\lg\nu = \frac{-Az^2\sqrt{\mu}}{1+aB\sqrt{\mu}}+C\mu,$$

where z is the valence of the ion whose activity is being calculated; a is the effective diameter of the ion, according to I. M. Klotts [1]; A and B are constants that characterize the solubility at the given temperature and pressure [3];

C is a constant that is a function of the dielectric constant, the degree of hydration and other factors [4]; and μ is the ionic strength, which is computed in accordance with the formula

$$\mu = (K_1C_1+K_2C_2+K_3C_3+\ldots+K_nC_n)\cdot\frac{10^{-3}}{2},$$

where C_1, C_2, C_3, ..., C_n are the concentrations of ions, in mg/liter; and K_1, K_2 and K_3 are the coefficients of the calculation.

Concentration of the CO_3 ion (in mg-ion/liter) was determined according to the formula

$$[CO_3] = \frac{Al_{carb}}{2+\frac{aH}{K_2'}},$$

where Al_{carb} is the carbonate alkalinity; H is the concentration of hydrogen ions; and K_2' is the concentration constant, which is computed in accordance with the formula

$$K_2' = K_2\cdot 10^{-10}\cdot\frac{\nu HCO_3}{\nu CO_3},$$

where K_2 is the thermodynamic constant [3].

The coefficient of saturation (r) was determined in accordance with the formula

$$r = \frac{a\,Ca\,a\,CO_3}{L_{CaCO_3}},$$

where L_{CaCO_3} is a constant; it is the thermodynamic product of the activity for calcium carbonate, which is a function of temperature and pressure [3].

The saturation coefficients of $CaCO_3$ for produced water that have been computed according to this methodology characterize the status of the system in a definite situation (the degree of its saturation). Calculation of the carbonate equilibrium of this water was carried out for three fields under different conditions of the deposition of salts, sources of flooding, and composition of the brine water and the produced water (table 1).

The Samotlor field takes Vakh River water for injection; salts were recorded for 120 wells on 1 January 1979.

At the West Surgut field, Cenomanian horizon water was used for injection, and salts were not observed.

For the Shaim group of fields, Konda River water was the source for flooding, and the brine water and the produced water were marked by an increased content of HCO_3 and CO_3 ions; salt deposition was recorded for 95 wells on 1 January 1979.

[redacted]

Table 1

Value of the Coefficient of the $CaCO_3$ Saturation (r) of Produced Water of West Siberian Fields

Well No	Date of sampling	Content of the component, mg/ℓ					pH	Total carbonate content mg-eq/ℓ	$r = \frac{a_{CaCO_3}}{L_{CaCO_3}}$ at reservoir temperature
		Na + K	Ca	Mg	Cl	HCO_3			
Samotlor field									
Stratum AV_1									
2857	Февраль 1976	6875,0	360,7	12,2	8508,0	48,8	7,85	0,8	0,66
1560	Сентябрь 1976	5099,6	400,8	12,16	6381,0	158,6	7,85	2,6	0,97
3077*	Январь 1976	3146,5	360,7	36,48	4254,0	189,1	7,98	2,5	8,57
3076*	Май 1976	3794,4	300,6	48,64	4963,0	85,4	7,98	1,4	9,01
Stratum AV_{2+3}									
1464	Март 1976	9947,9	1022,0	109,3	13471,0	48,8	7,75	0,8	0,93
1490	Март 1976	2163,8	140,28	48,6	2836,0	48,8	7,70	0,8	0,85
Stratum AV_{4-5}									
2764	Октябрь 1973	8965,4	561,7	352,6	1524,4	1024,8	6,9	16,8	0,7
3387	Май 1974	2585,2	160,3	85,12	4254,0	451,4	6,5	7,4	0,35
1586	Май 1974	7107,0	1062,1	109,4	1311,6	61,0	6,1	1,0	0,014
2048*	Апрель 1976	12021,8	460,9	316,16	14889,0	1024,8	7,6	16,8	4,06
2532*	Апрель 1976	7123,8	160,3	133,76	8508,0	536,8	7,74	8,8	5,31
2013*	Апрель 1976	9337,2	881,8	340,5	13116,5	195,2	7,64	3,2	2,41
Stratum BV_8									
303	Сентябрь 1971	8303,0	1503,0	182,4	15952,5	61,0	7,2	1,0	0,14
12	Июнь 1971	8956,8	1923,0	36,5	17016,0	512,4	6,6	8,4	0,5
4644	Январь 1973	8602,0	2064,1	48,6	17016,0	61,0	8,1	0,1	0,2
4530*	Апрель 1974	7912,0	1603,0	24,0	14889,0	366,0	7,9	6,0	11,4
4531*	Декабрь 1974	6049,0	561,0	24,2	10280,5	183,0	7,88	3,0	6,0
4525	Август 1974	5598,2	301,16	133,76	10280,6	268,4	7,22	4,4	0,9
4525*	Декабрь 1974	5188,8	721,4	48,6	9217,0	341,6	7,68	5,6	9,0
4917*	Июль 1975	8356,0	2124,0	24,2	1661,0		9,26	1,4	15,0

Table 1 (continued)

West Surgut Field										
Stratum BS_{10}										
253	Июнь	1975	6572,0	376,0	84,0	10944,0	170,0	7,55	2,8	1,33
277	Февраль	1975	7178,0	476,0	96,3	12050,4	231,8	7,4	3,8	0,58
107	Январь	1974	6836,0	357,0	60,19	11233,6	195,2	7,4	3,2	1,01
203	Январь	1974	6121,0	317,0	36,0	10005,0	170,8	7,4	2,8	0,715
111	Февраль	1974	6511,7	297,5	36,11	9730,2	219,6	7,4	3,6	0,82
Stratum BS_1										
186	Февраль	1975	6896,0	376,8	48,15	11347,0	158,6	7,4	2,6	0,56
10	Февраль	1975	5729,5	168,5	30,09	9042,3	274,5	7,4	4,0	1,01
7-K	Февраль	1974	6089,9	297,5	36,11	9903,9	201,3	7,4	3,3	1,05
Mixture of reservoir water (Valanginian) with injected water (Cenomanian)										
162; 15 бис (1)*			6000,7	297,52	60,19	9829,5	213,5	7,4	3,5	1,08
162; 15 бис (2)			6000,7	297,5	60,19	9829,5	215,5	7,4	3,5	1,08
162; 15 бис (3)			6046,2	317,3	84,2	10005,0	213,5	7,4	3,5	1,125
162; 15 бис (4)			6137,3	337,1	84,2	10180,4	213,5	7,4	3,5	1,0
162; 15 бис (5)			6228,4	357,0	84,2	10355,9	213,5	7,2	3,5	1,18
162; 15 бис (6)			6399,4	357,0	96,3	10531,5	213,5	7,0	3,5	1,21
162; 15 бис (7)			6365,0	376,8	120,3	10707,0	213,5	7,2	3,5	0,78
162; 15 бис (8)			6444,6	396,7	120,3	10882,5	183,0	7,4	3,0	1,04
162; 15 бис (9)			6626,7	416,5	132,4	11233,6	183,0	7,4	3,0	1,05
Shaim group of fields										
Trekhozernava (P)										
7	Ноябрь	1974	8252,4	70,1	48,8	8981,5	6893,0	14,4	17,8	48,57
486	Ноябрь	1974	2336	90,0	36,6	3159,5	1220,0	6,2	8,1	43,64
506	Ноябрь	1974	2937,1	70,0	48,3	3585,5	2074,0	10,8	8,1	80,7
515	Ноябрь	1974	2099,9	100,0	21,9	2094,5	2379,0	6,2	7,8	73,5
523	Ноябрь	1974	7992,1	70,0	34,2	7703,5	8357,0	6,2	7,9	23,57
63	Июль	1975	1870,8	200,0	12,2	2343,0	1586,0	16,4	6,9	16,4
Mortym'ya-Teterevskoye (P)										
664	Август	1975	129,4	25,0	12,2	106,5	274,5	6,1	7,1	17,8
876	Август	1975	5503,4	514,0	107,4	9301,0	690,0	14,4	7,8	50,1

#bis
*Wells in which, according to oilfield investigation data, depositions of salts have been observed (in percents): (1)--90 (BS_1) and 10 (Cenomanian); (2)--80 (BS_1) and 20 (Cenomanian); (3)--70 (BS_1) and 30 (Cenomanian); (4)--60 (BS_1) and 40 (Cenomanian); (5)--50 (BS_1) and 50 (Cenomanian); (6)--40 (BS_1) and 60 (Cenomanian); (7)--30 (BS_1) and 70 (Cenomanian); (8)--20 (BS_1) and 80 (Cenomanian); (9)--10 (BS_1) and 90 (Cenomanian).

At the Samotlor field, the coefficient r (computed for reservoir conditions) changed over a broad range--from 0.01 to 25. In this case, r>1-2 for the produced water of wells at which, according to oilfield study data, salt deposition had been established (at the time salts were detected), and r<1-2 where salts had not been detected. High saturation coefficient values were noted for produced water (r>>1-2) in wells that were flooded by injected water in which salts had precipitated.

Maps that have been constructed of saturation coefficients for produced water that take into account the data of the developed deposit, the distribution of injection rows and the amount of flooding of development wells have enabled salt deposition zones to be predicted (figure 1).

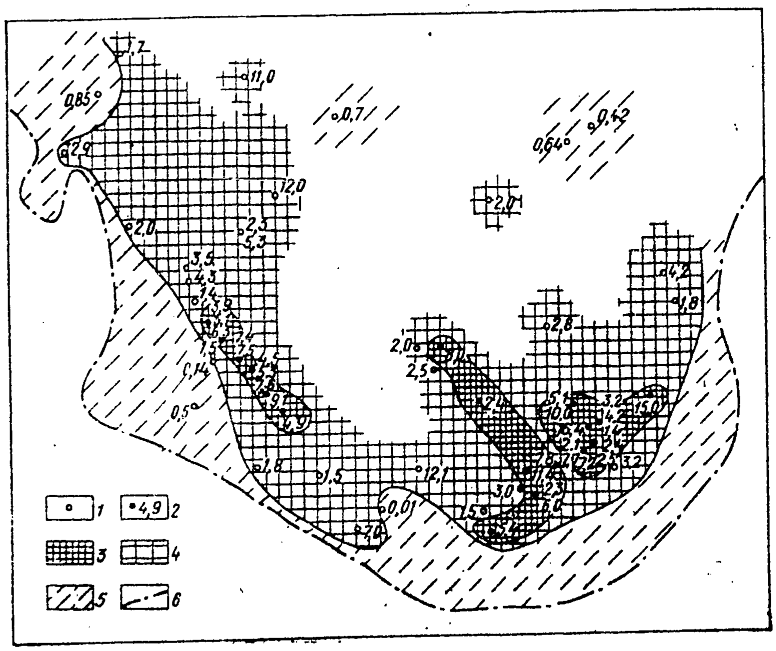

Figure 1. Map of Distribution of the Coefficient of $CaCO_3$ Saturation in the Water of Stratum VB_8 of the Samotlor Field.

Key:
1. Wells in which deposition of salts have been noted, according to oilfield research.
2. Values of $CaCO_3$ saturation coefficients.

Zones:

3. Water supersaturated with $CaCO_3$ ($r > 1$) and deposition of salts recorded in accordance with oilfield research data.
4. Water supersaturated with $CaCO_3$ ($r > 1$).
5. Water not saturated with $CaCO_3$ ($r < 1$).
6. Outer boundary of the presence of oil.

When the field was further developed, the correctness of the breakdown of the zones was confirmed (figure 2).

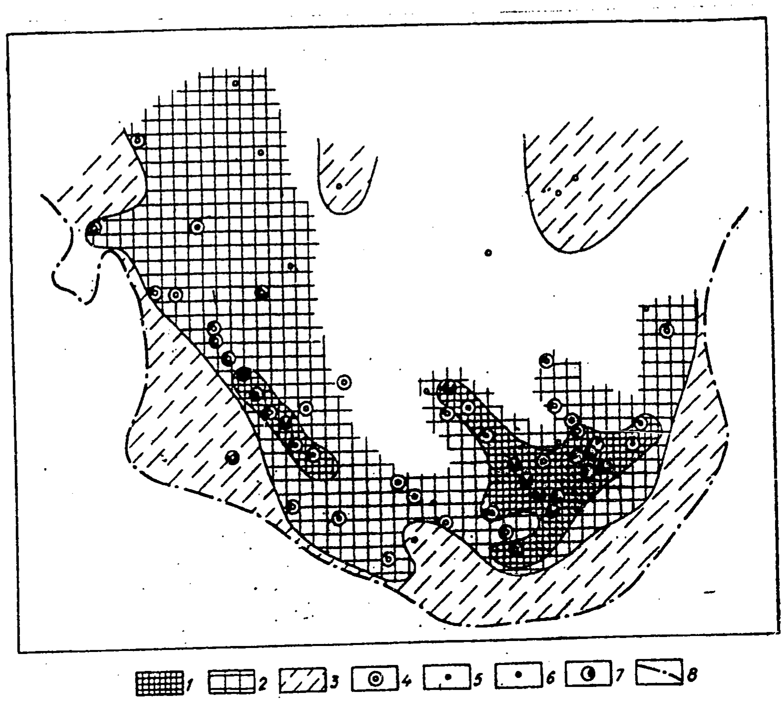

Figure 2. Diagram of Distribution of Zones of Various Degrees of Probability of Deposition of Salts Where t = 70 degrees C. (Stratum BV_8 of the Samotlor Oilfield).

Key:

Zones of:

1. Deposition of salts (according to calculated data and oilfield observations).
2. Possible deposition of salts (according to calculated data).
3. Absence of deposition of salts.

Wells:

4. In which deposition of salts was noted on 1 January 1979.
5. In which salt deposition was recorded according to the oilfield research data (supersaturation of water was established according to the calculated data).
6. In which saturation of reservoir water with $CaCO_3$ was established in accordance with the calculated data.
7. Water encroachment of the product.
8. Outer boundary of the presence of oil.

Salt deposition was noted, according to oilfield observation results, in those wells for which these salts had been forecast by the computational method.

Disturbance of the carbonate equilibrium is a function, to a considerable extent, of temperature, so the coefficients of $CaCO_3$ saturation of the water that were computed for temperatures of lower strata permits the assumption that salts will be deposited both in well bores and in inner surfaces of oilfield equipment.

The coefficient values computed for temperatures of 50 and 20 degrees C, which correspond to the temperature regime in the well bore and in the equipment on the surface, indicated high agreement with the results of oilfield observations (table 2). The methodology examined above will not only enable assessment of the potential for salt deposition in wells and surface equipment but also forecasting of sections where this process can occur under reservoir conditions. At the same time there are no factual data that confirm the deposition of salts in the reservoir rocks of stratum BV_8 because of the difficulty of diagnosing them. But where conditions are close to those of the reservoir (in the bottom hole area and in submerged electric pumps), salt deposition is frequently observed.

The water saturation coefficients of the water (0.7-1.2) that is formed as a result of the mixing of Cenomanian water and brine water of the West Surgut field testify that they are undersaturated with $CaCO_3$.

The saturation coefficients computed under this methodology for the produced water of the Shaim group of fields, both for wells with salt deposits and for wells where they have not been observed, are marked by high values (up to 80).

The studies that were made indicated that the injection of Cenomanian water does not lead to salt deposition, while the pumping of fresh water does, that is, the deposition of carbonate salts during development of Samotlor oilfield oil strata was caused by disturbance of the carbonate balance of the system made up of the residual water in the stratum and the injected water--the result of injecting Vakh River fresh water, which was incompatible with the reservoir water. In this case, one of the most important prerequisites for preserving the indicated equilibrium is the balance of dissolved carbon dioxide with hydrocarbonate and carbonate ions. A balanced CO_2 concentration satisfies the prerequisite for a stable condition for the whole system.

Unlike the water of the Cenomanian horizon, Vakh River water contains from 5.7 to 16.2 mg/liter of CO_2. The equilibrium of the CO_2 concentration therein, which is computed according to the formula

$$CO_2 = \frac{K_2}{K_1 L_{CaCO_3}} (\nu HCO_3)^2 [HCO_3]^2 \nu Ca[Ca],$$

consists of 0.038 millimoles/liter, or 1.76 mg/liter, that is, the amount of CO_2 is 4-fold to 8-fold greater than is required for balance, or the water is extremely aggressive, which leads to disturbance of the physical and chemical equilibrium in the residual-water injected-water system.

Thus, compatibility of the injected water and the residual water (water that is close in composition to the reservoir water) is a definite prerequisite when

Table 2

Value of Coefficient of $CaCO_3$ Saturation (r) of Produced Water of the Samotlor Oilfield

(1) Номер скважины	(2) Место выпадения солей	(3) Температура на устье скважины, °С	(4) Дата обнаружения солей	(5) Дата отбора пробы	(6) Содержание компонентов, мг/л					pH	(7) Общая карбонатность, мг-экв/л	$r=\frac{a_{Ca}\,a_{CO_3}}{L_{CaCO_3}}$ (8) при t, °С		
					Na+K	Ca	Mg	Cl	HCO_3			70	50	20
315	(9) С поверхности рабочих колес	55,5	IX 1974	III 1975	2842,2	360,7	12,2	4 963	158,6	7,68	2,6	4,5	2,63	1,12
470	То же (10)	53,0	XI 1974	IV 1975	4448,2	761,5	12,5	8153,3	146,4	7,75	2,4	5,4	3,40	1,32
4530	» »	52,0	VI 1974	IV 1974	7912	1 603	24	14 889	366	7,9	6,0	10,7	7,69	2,73
				III 1974	8556	3 000	24	18 466	244	8,0	4,0	7,2	5,94	2,87
РВС (14) № 9	С глубины 1500 м (11)	—	—	IV 1974	5087,6	861,7	133,76	9571,5	317,2	8,0	5,2	15,85	10,21	4,0
3001	30 м низа НКТ (12)		VI 1974	VIII 1974	12 903	460,9	12,2	20 561	244	8,35	5,0	3,2	2,02	1,36
4531	С поверхности двигателя, с рабочих колес (13)		VII 1974	VIII 1974	4 434	731,5	24,3	8153,5	170,8	7,7	2,8	7,1	3,23	1,56

Key:

1. Well number.
2. Place of salt deposition.
3. Well-head temperature, degrees C.
4. Date of detection of salts.
5. Date of sampling.
6. Content of components, mg/liter.
7. Total carbonate content, mg-eq/liter.
8. At a temperature of, degrees C.
9. From the surface of the runners.
10. Ditto.
11. From a depth of 1,500 meters.
12. 30 meters below the NKT.
13. From the surface of the motor, and from the runners.
14. RVS.

choosing sources of water supply and methods for the preparation thereof in a PPD [reservoir-pressure maintenance] system. The method of computing the carbonate balance for purposes of forecasting the deposition of salts can be used also for other West Siberian deposits that are marked by similar hydrogeological conditions.

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PECULIARITIES OF ANOMALOUSLY HIGH FORMATION PRESSURES IN OIL, GAS WELLS STUDIED

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 4, Apr 80 signed to press 30 Nov 79 pp 36-40

[Article by V. S. Melik-Pashayev, V. V. Vlasenko, V. N. Seregina and M. A. Titunina (VNII [All-Union Scientific-Research Institute for Petroleum]): "AVPD [anomalously high formation pressure] in the USSR's Oil and Gas Fields"]

[Text] In this article the authors analyze data on 350 UV [hydrocarbon] deposits, the selection of which was based mainly on actual measurements of reservoir pressures in cased wells, as well as on data from horizon sampling with drill-stem testers. This solution was adopted because the reservoir pressure that is computed on the basis of density of the mud that is used in drilling proves basically to be overstated. Formation pressure values obtained by oilfield geophysics methods were not used.

During the work it became necessary to validate the lower limit of the coefficient of the high anomalousness of formation pressure (k_a), since the numerical indicator of this limit was not single-valued for various researchers.

By k_a is meant the ratio of formation pressure to the hydrostatic pressure computed conventionally for the same depth. Solution to the question of a lower limit for AVPD can be approached from two standpoints: that of the highest value of density of the brine water as a result of its mineralization, and that of the conditions for drilling wells at stratigraphic complexes in which AVPD is absent.

If brine waters are examined from the point of view of their maximum mineralization, then it should be noted that the density of even the most highly mineralized waters does not, under the most favorable geological conditions for their appearance, exceed 1.2-1.22 g/cm^3 (the DDV, the Ciscarpathian trough, and West Ciscaucasia).

On the other hand, in areas where AVPD is unknown, wells are drilled with mud with a density of 1.2-1.25 g/cm^3.

Therefore, a pressure that requires weighting of the drilling fluid with hematite, barite, and so on, for the execution of normal drilling, must be considered to be anomalously high.

Thus, when considering maximal mineralization of the brine waters and the normal conditions for drilling wells without using mud-weighting materials, 1.2 can be adopted as the lower limit k_a of reservoir pressure that is categorized as anomalously high. The upper limit of this coefficient theoretically should be considered the ratio of overburden pressure to hydrostatic pressure, which is 2.3.

The authors restrict themselves in this article to use of the methods of mathematical statistics, to establishment of the frequency and to distribution of the formation-pressure gradients, and to finding their dependence upon the depth of deposition of the horizons.

For this purpose, all the deposits examined, which relate to the Azov-Kuban' NGO [oil and gas bearing region], the Ciscarpathian trough, the NGO of the Fergana intermontane depression, the Apsheron NGR [oil and gas bearing district], the Baku Archipelago, the Nizhnyaya Kura NGR, the Balkhan NGR, the Caspian depression, the Black Sea-Crimea, Middle Ob', Tersa-Sunzha and Tersa-Caspian NGO's, the Lena-Vilyuy NGP [oil and gas bearing province], the Pripyat' depression, the DDV and the Surkhan-Vakhsh NGO were placed in a field, the bounds of which were the values of the hydrostatic and geostatic pressures (figure 1).

In analyzing the chart of formation pressures as a function of the depth of deposits with AVPD, a number of interesting observations can be expressed. Certain researches have previously noted that AVPD is characteristic for depths of more than 3,000 meters, but it is obvious from the chart presented that in some oil and gas bearing regions that are confined to tectonically active geosynclinal fold zones, AVPD begins to appear at depths of just 400-500 meters. Thus, for example, within the West Apsheron zone, the Baku Archipelago and the Kura lowland of Azerbaijan, the minimal depths of appearance of AVPD are associated with the crestal portions of uplifts that are complicated by mud vulcanism. Nearly the same situation is observed in oilfields of the Balkhan zone of Turkmenia, where the minimal depths for the deposits of the red-rock series are noted in the more elevated zones of folds (the Dagadzhik field, 560 meters), in the gas deposits of the inner zone of the Ciscarpathian fore-trough, and in the fields of the Surkhan-Vakhsh NGO of Tadzhikistan.

As is apparent from the chart (see figure 1), some deposits are situated in zones in which formation-pressure to hydrostatic-pressure ratios approach the value of the overburden-pressure gradient. Thus, of all the deposits examined, 6 were in the 2-2.1 interval, 4 in the 2.1-2.2 interval, and 2 in the 2.2-2.3 interval (table 1).

Thus, only solitary deposits possess maximal k_a that is close to overburden (geostatic) pressure.

The distribution of deposits by their position between the hydrostatic pressure (the density of the water is 1 g/cm^3) and the overburden pressures (average density of the rock is 2.3 g/cm^3) indicates that the frequency of occurrence of deposits with AVPD appears to be as follows, with regard to k_a: 72 percent for 1.3-1.8, 9 percent for 1.8-2 and only about 3.5 percent for 2-2.3 (figure 2). Change of k_a with depth is of major interest.

The data of average k_a values are examined at intervals of 1,000 meters in table 2.

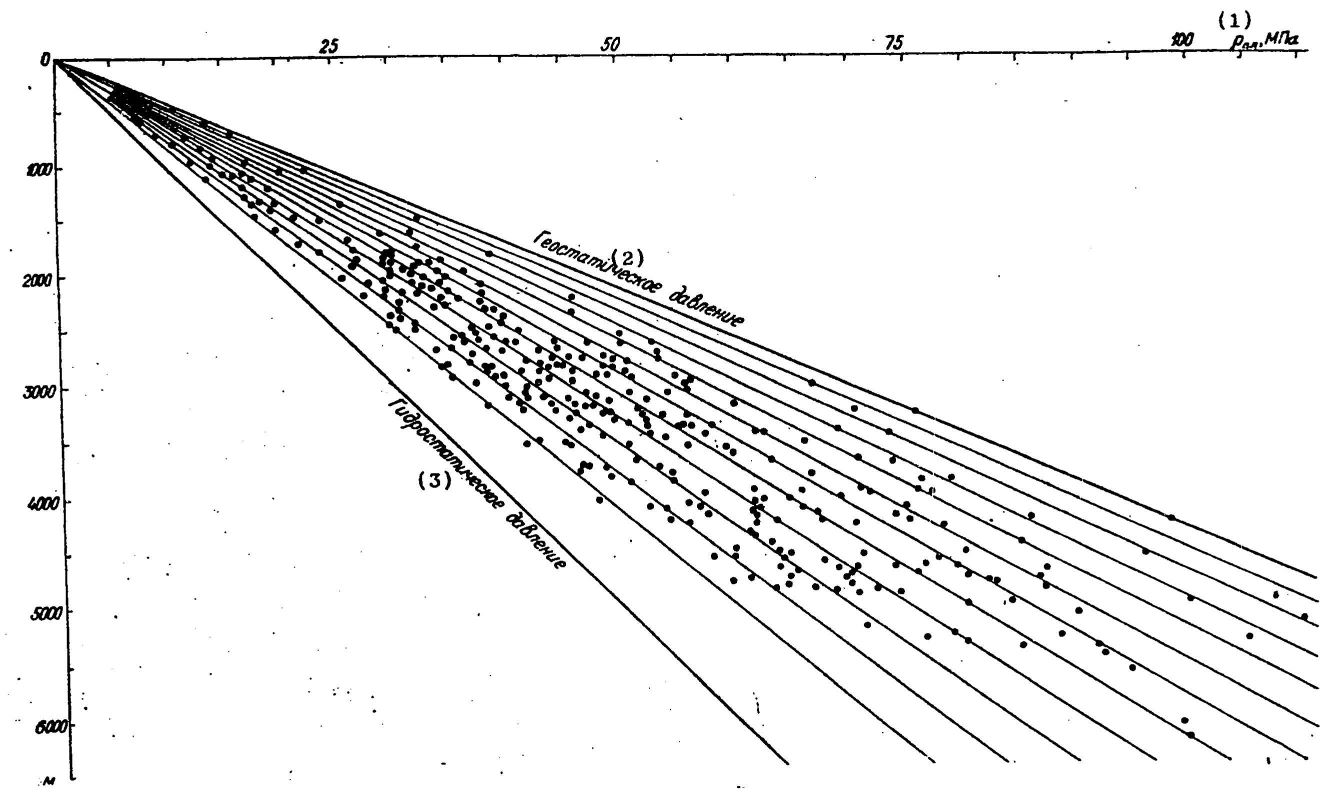

Figure 1. Formation Pressure as a Function of the Depth of Deposits with AVPD [anomalously high formation pressure].

Key:

1. $P_{пл}$, MPa [formation pressure, megapascals].
2. Geostatic pressure.
3. Hydrostatic pressure.

Table 1

Distribution of USSR Oil and Gas Strata by Coefficient of Anomalousness

Intervals of k_a	Number of deposits	Frequency, percent
1.2-1.3	50	14.5
1.3-1.4	59	17.0
1.4-1.5	59	17.0
1.5-1.6	57	16.5
1.6-1.7	46	13.3
1.7-1.8	31	9.0
1.8-1.9	18	5.2
1.9-2.0	13	3.8
2.0-2.1	6	1.7
2.1-2.2	4	1.2
2.2-2.3	2	0.6

Table 2

Change of Average Values of Coefficients of Anomalousness with Depth

Depth interval, in meters	Number of deposits	K_a limits	Average value of k_a
Less than 1,000	20	1.47-1.78	1.58
1,000-2,000	42	1.25-1.78	1.55
2,000-3,000	105	1.37-1.59	1.51
3,000-4,000	91	1.45-1.68	1.58
4,000-5,000	70	1.46-1.69	1.57
5,000-6,000	13	1.53-1.75	1.68

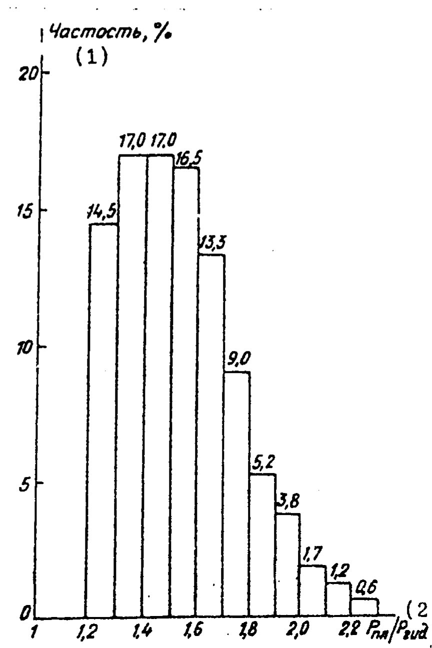

Figure 2. Diagram of Distribution of Coefficients of Anomalous Formation Pressure for USSR Oil and Gas Bearing Regions:

Key:

1. Frequency, percent.
2. $P_{пл}/P_{гид}$ [formation pressure/hydrostatic pressure].

Despite the fact that the number of deposits at depths of less than 5,000 meters varies between 20 and 105, the average ratios of formation pressure to hydrostatic pressure change practically not at all, experiencing fluctuations in the 1.51-1.58 range. However, below the 5,000-6,000 meter interval, a trend toward an increase in the value of this ratio to 1.68 is noted. Below this depth, where there are only solitary points, the nature of further change of k_a cannot be judged.

Twelve, or 3.5 percent of the total number of deposits examined, possess maximum values of k_a (from 2 to 2.3), and only two, or 0.6 percent, have values from 2.2 to 2.3. It must be supposed that the existence of oil and gas deposits with AVPD close to the overburden pressure is theoretically possible where conditions are more favorable for the action of pliant rocks (rock salt, clay) along crevices directly on the fluid of the deposit. However, such geological conditions for the emergence of formation pressures that are close to the overburden pressures are fairly rare in the deposits. Basically, the pressure in an oil or gas deposit should not reach the overburden pressure. A generalization of oilfield data about the hydraulic fracturing of strata indicated that this phenomenon sets in at various pressure gradients as a function of natural fissuration, the degree of cementation, and so on. It must be supposed that the pressure at which hydraulic fracturing of strata occurs will be close to the maximum value of the AVPD for a specific deposit.

It should be noted that, along with AVPD, in deposits situated at depths of more than 4,000 meters, there are also normal pressures that are close to hydrostatic pressures. Thus, for example, in the DDV there are strata with normal pressure where there is AVPD in oil and gas deposits of coal measures. In the Gadyach area, at a depth of 5,109 meters, the ratio of formation pressure to hydrostatic pressure is 1.08, while in the Upper Poltava area, at a depth of 5,150 meters, the ratio is 1.1, that is, the formation pressure is not anomalous and it almost corresponds to the hydrostatic pressure.

The data of well drilling at the Tatar antecline, near the village of Minnibayevo, which reached a depth of 5,099 meters, 3,215 meters of which passed through rocks of Archeozoic age, is of considerable interest, testifying to the absence of AVPD in crystalline basement rocks. Especially important are the results of a study of the lower part of the log where a stream of water with a flow of 81 m^3/day was obtained in the 4,876-5,005 meter interval at a formation pressure of 54.4 MPa and a water density of 1.228 g/cm^3 (R. Kh. Muslimov et al, 1979).

Change in absolute value by depth interval is shown in a chart (figure 3), from which it is evident that in the 5,100-5,500 meter interval the pressure varies within the 92-94.6 MPa range. In the Shevchenkovo area, the formation pressure reaches 120 MPa in well No 1 at a depth of 7,010 meters. The results of studies at a superdeep well on the Kola Peninsula will be of special significance for the characteristics of formation and overburden pressures.

The following conclusions can be drawn, based upon what was said above:

1. In geosynclinal folded areas, deposits with AVPD are found on the log for sediment series at depths of 400 to 6,000 meters and more.

2. In some oil and gas bearing provinces of the USSR, average k_a values fluctuate within

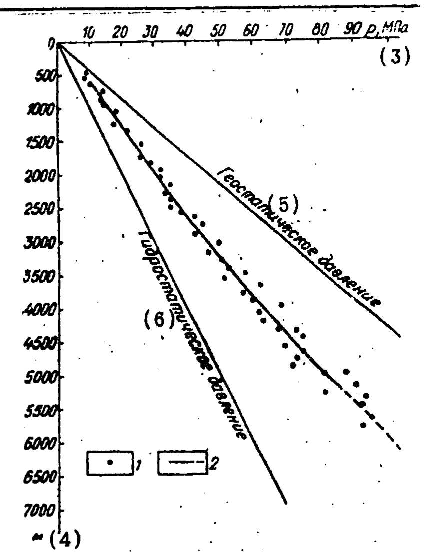

Figure 3. Curve of Change of Average Formation Pressure by Depth Interval for Deposits with AVPD.

Key:

1. Average value of the formation pressure for the 100-meter interval.
2. Curve of the increase of formation pressure with depth.
3. MPa [megapascals].
4. M [meters].
5. Geostatic pressure.
6. Hydrostatic pressure.

a small range (1.51-1.58), achieving the greatest value (1.68) in the 5,000-6,000 meter depth interval.

3. Formation pressure gradients that are computed according to density of the drilling mud used in drilling the well are overstated, and, as a rule, are greater than the initial formation pressure gradients of the oil and gas deposits.

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BOOK EXCERPTS: MOSCOW CENTRALIZED HEATING SYSTEM

Moscow TEPLOFIKATSIYA MOSKVY (The Moscow Centralized Heating System) in Russian 1980, pp 165-173, 186, 187

(Annotation, table of contents, chapter eight from book by Ye. Ya. Sokolov et al, Editors I.N. Yershov and I.N. Serebryanikov, Izdatel'stvo "Energiya", 188 pages)

[Text] The book depicts the features in the development of the Moscow centralized heating network as one of the major elements of the economy of the city under a socialist society. The book uses the Moscow centralized heating system, the largest in the world, to show that the wide scope of centralized heating in our country is a great social achievement of Soviet society.

The book is intended for the wide circle of engineer readers interested in advances in the area of centralized heating system development. It may also be of interest to the foreign reader.

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Chapter 8: Prospects for the Growth of the Moscow Heat Supply in 1990

It is difficult to find an area in Moscow where they are not building housing, cultural and personal service, administrative, and other types of buildings and structures. Old buildings, having historical or architectural value, are being restored so that they will become architectural and historical monuments to the old days. Old and valueless structures are being demolished and in their place are being built new modern buildings answering high urban development requirements--Young Pioneer palaces, sports facilities, commercial complexes, theaters, museums, exhibition halls, administrative buildings, and housing.

The future 11th and 12th five-year plans will also see the creation and further development of the city.

The intensive build-up of the city will continue in accordance with the general plan for the development of Moscow during the 11th and 12th five-year plans. The volume of housing construction will let each inhabitant of Moscow have 12 square meters of living or 19 square meters of total housing space. They plan to locate the basic part of the city institutions in the general city center system and the corresponding district institutions in the housing area centers.

By 1990 they plan to construct in Moscow a large number of theaters, concert and exhibition halls, museums, palaces of culture and clubs, movie theaters, Young Pioneer palaces, libraries, stores, public dining facilities, hotels, hospitals, and other buildings of a cultural and personal nature.

However, Moscow is also an industrial center. Its industry too will be developed and improved. Industries which pollute the environment will be moved out beyond the city limits.

The housing, municipal and everyday buildings, cultural and sports complexes, and industrial enterprises which they intend to construct must be centrally heated. Thermal power is required for heating, a hot water supply, ventilation, conditioning, and the technological needs of industry.

The annual heatong load growth rate in the 1980-1990 period will be about 4.5-5 percent. The heat load density on the average for Moscow will increase to 0.82 megawatts per year/0.7 gigacalories/(hours x years)/.

The general trend in supplying heat to the new projects planned for construction in the 1980-1990 period will be, as in the past 50 years, a centralized heat supply based on the combined output of thermal and electric power at a TETS. This trend is based on conclusions stated in the preceding chapters of this book, namely: fuel savings, a decrease in environmental pollution, creation of high hygienic and comfort conditions for the population, and an increase of labor productivity in the power industry.

The following positions have been adopted in determining the level of development of centralized heat supply sources in 1990--providing 100 percent of the heating, ventilation, and hot water supply load of the housing, administrative and public, and cultural and personal sectors; providing 70 percent of the heating, ventilation, and hot water supply load of the production sphere(industrial enterprises, scientific research institutes, design bureaus with experimental shops, planning institutes, and specialized higher and secondary educational institutions); the partial provision of heat for the protective forested parkland zone of the city; the limited provision of industrial enterprise steam loads.

Under these specified situations they require a centralized heat source capacity(in hot water) of about 46,780 megawatts(40,155 gigacalories per hour) when retaining a part of the industrial boiler systems to cover a thermal load of about 4,890 megawatts(4,200 gigacalories per hour).

Two options to provide the required thermal power for the development of heat sources are being examined: organic fuel and nuclear fuel. The development of organic fuel heat sources is being examined in two sub-options. The first sub-option is to develop Moscow TETS with the retention of a centralized heating system coefficient at a level of 0.5-0.6 by the installation of centralized heating system turbines, mainly the T-250-240, and also the T-100-130 and PT-80 turbines. This is the sub-option of the maximum development of centralized heating systems. Moreover branch TETS-9, and TETS-21, 23, 25, and 26 will attain maximum expansion. By maximum expansion we mean the maximum possible number of boilers, turbines, and PVK/expansion unknown/ which can be installed while still maintaining the established environmental pollution health standards and the possibility of placing these machine units on the TETS premises.

At the same time that they are installing new centralized heating system blocks at the branch of TETS-9 and at TETS-21, 23, 25, and 26, they are also considering the reconstruction of TETS-9, 11, and 12 by replacing the obsolete and physically worn-out machine parts with new ones having a larger unit capacity and high steam parameters. They envisage completing work on the maximum broadening and reconstruction of the Moscow TETS before 1990.

The construction of the Northern TETS is beirg planned along with the widening and reconstruction of the existing Moscow TETS. The technical and economic explanatory documents for the Northern TETS will be 42,300 megawatts(36,300 gigacalories per hour) by the end of 1990, and the electrical capacity--11,260 megawatts.

Besides the TETS in operation must be found 21 existing RTS/expansion unknown/ to include the development of their thermal capacity to 6,700 megawatts(5,750 gigacalories per hour) and two new RTS with a total thermal capacity of 932 megawatts (800 gigacalories per hour). The total capacity of the RTS amounts to 7,630 megawatts(6,550 gigacalories per hour).

The share of covering thermal loads with various heat sources in 1990 will be as follows: 75 percent from TETS, 15 percent from RTS, and 10 percent from local sources. By local heat sources we mean building and small city block boiler systems.

The basic type of fuel for practically all Moscow TETS will be gas because its use causes only minimal environmental pollution.

The second sub-option--the development of the Moscow TETS using organic fuel--lowers the centralized heating system coefficient to 0.3-0.35.

The build-up of thermal capacity at TETS-8(branch of TETS-9) and TETS-21, 23, 25, and 26 will be mainly through the installation of hot-water boilers. They intend to modernize TETS-9, 11, and 12. The construction of new TETS is not envisioned. The established capacity of the Moscow TETS in this sub-option will amount to the following in 1990: electric power--8,150 megawatts; thermal(in the form of hot water)--33,600 megawatts(28,830 gigacalories per hour); and engineering steam--3,400 hundred tons per hour. The thermal capacity of the RTS must be increased to 13,800 megawatts(11,810 gigacalories per hour).

An analysis of the technical and economic calculations has shown that the option favoring the maximum development of the centralized heating system is the most economical. Moreover, a savings of about 2.5 million tons of conventional fuel per year and 130 million rubles of capital investments will be achieved. Another option has not been ruled out--the option of constructing ATETS/atomic heat and electric power plants/ or AK/atomic boiler systems/.

The creation of centralized heating systems with ATETS or AK requires the solution of a number of serious scientific and technical problems of which the following are the most important: the selection and development of new types of centralized heating system equipment, the selection and creation of new centralized heating systems and equipment for high-extension transit networks, the creation of automatic control systems, the use of purified drainage water for ATETS and AK industrial water supply, and a whole series of other things.

In the case of the Moscow power system, which possesses a high share of centralized heating system equipment, the question about TETS participation in regulating the variable electric load schedule looms sharply now and in the future. The most effective way to regulate loads in similar cases is to construct water storage stations which, using the surplus TETS electrical capacity during the night-time hours, can distribute it in the peak hours by the specific expenditure of fuel in the heating period of 200-300 grams per (kilowatts x hours). The construction of such a station in the Mosenergo/Moscow Regional Administration of Power System Management/ system, with a capacity of 1,200 megawatts, has already begun. In the 10th five-year plan they intend to put the first machine units of this GAES/pumped-storage electric power plant/ into operation. Research on the siting of a second GAES has begun.

One of the interesting and long-range trends in the area of heat supply, which will permit a decrease in fuel expenditure, is the use of compression type heat pumps utilizing disposed-of, low-potential heat for heat supply purposes. The use of heat pump and heat accumulation systems will permit them to fill night schedule electrical load gaps.

The heat supply boiling system is now being studied for the use of the low-potential heat of waters disposed by the city whose temperature even in the wintertime is maintained at a level of 16 degrees C.

There is long-term work going on to create absorption refrigerators which will use the thermal power of hot water to produce cold. This will permit an increase in TETS summer thermal loads.

Heating networks and their components are an important part of a centralized heat supply. The Moscow thermal networks have been developed as radial ones. Gradually the end sections of the trunk heating systems from the various TETS have been joined together. However, these end sections, as a rule, have relatively small pipe diameters, 400-600 millimeters, which reduce the possibility of the parallel working of a TETS on a common heating trunk and, consequently, of mutual redundancy. At present and in the future the trunk networks, connecting the neighboring TETS to each other, are being built and will be built to include the possibility of mutual redundancy, i.e., the practically identical pipeline diameter over the entire extent of the trunk. This causes an increase in capital investments in the construction of networks which is justified by an increase in the reliability of the heat supply.

Besides an increase in dependability, the opportunity to have two TETS with different economic indicators connected makes it possible to cover the summer heating load with the more economical equipment of one of the TETS. The question of a reliable and quality heat supply for the Moscow customers is of paramount importance.

The following are the basic ways to increase the reliability and longevity of the heating main and to have an uninterrupted heat supply: protection of the pipes from external corrosion, the use of more improved equipment in the thermal networks(fittings, compensators, pumps, etc.), the use of more reliable building materials, the wide use of automation and remote control, an increase in the level of operation and high-quality conduct of preventive maintenance and repair work.

The most effective way to protect pipelines from external corrosion is to apply a protective coat of vitreous enamel to the outer wall of the pipe. By 1985 they will construct several shops for the application of vitreous enamel coatings which will cover the requirement for coating pipes with vitreous enamel for repair work needs. The life of pipelines with a vitreous enamel covering, according to the most modest estimates, will double and the cost of constructing the shop will pay for itself in one and a half to two years. The pipe-milling plants must supply pipes with the coating already on them for the pipelines to be built in the 1985-1990 period.

The reliability and economy of transporting heat depends, to a significant degree, on effective and high quality thermal insulation. The search for effective thermal insulation materials is being conducted continually. The thermal insulation materials being used now do not fully satisfy the high requirements resulting from difficult operating conditions(high humidity and temperature). The insulation, especially on large-diameter pipelines, is installed right on the route during the construction work. This does not provide for a high quality work production, it requires high labor expenditure, and it lengthens the construction time.

By 1990 all of the thermal insulation work, with the exception of abutment joints and the individual sectors with equipment, must be done at special plants before installation. This will significantly increase the quality of insulation installation, and will decrease labor expenditure and the length of thermal network construction.

The construction of reserve connections will be continued as a way to further increase reliability. Reserve connections tie two or more neighboring trunks together which permits, during the emergency switch-off of one from the heating trunk, the supply of heat to the customer over the other. The further strengthening of connections between heat sources--TETS and RTS--will be continued.

The selection of a connection circuit of customers is an important factor in increasing the reliability of the heat supply. About 70 percent of the heating load is now connected by a dependent circuit which does not permit in the return line of the thermal network an increase of pressure of the cast-iron heaters which are above the maximum, limited by the mechanical strength. For this very reason difficulties arise in the mutual redundancy of the heat trunks and when switching the thermal network over to a supply from another heat source.

To maintain permissible pressure in the return trunk one must, in a number of cases, construct pumping stations and provide for an increased pipeline diameter which leads to a rise in thermal network costs and complicates their operation. According to the reasons stated, they plan to make wide use of a heat connection independent circuit so that in 1990 50 percent of the heating load will be connected by an independent circuit.

The connection of the hot water supply load in 1990 will be directed at a two-stage gradual circuit which is more economical in comparison with other connection schemes. One of the trends in increasing the reliability of the heat supply system is the use of a new circuit connecting distribution thermal networks to trunk ones through the KRP [checking and clearing points]. Figure 79 shows the principal KRP circuit and the connection of subscribers through the KRP. The connection of distribution thermal networks to trunk ones through the KRP provides for the possibility of a clear division of thermal networks on the trunk and distribution ones, makes it possible to manage the hydraulic mode and to conduct an independent temperature mode in distribution networks, to more effectively determine the location of damages, their localization and elimination, and to increase hydraulic stability and lower heat losses. They intend to construct 120 KRP's in the 1980-1990 period.

The increase in the cost of constructing heating systems was the basis for raising the question of increasing the calculated temperature in the feed line of a thermal network. However, the calculations which have been made have shown that the transfer from a calculated temperature of 150 degrees C to 170 degrees C does not yield an appreciable economic advantage. Therefore such a transfer is not intended on a broad scale by 1990.

Reinforced concrete will be the basic building material in constructing thermal network structures.

The achievement of significant savings in materials, labor expenditures and construction cost, and also an improvement in operating conditions, undoubtedly will become the aim in the development of construction designs. The main ways to achieve these goals will be the following: decreasing the sizes of the reinforced concrete element sections by using high-strength concretes and steels; the mass transfer to full prefabrication of all building structures during the maximum enlargement of the prefabricated elements themselves, whose sizes are limited only by their transportability; the manufacture at plants of complete prefabricated articles, simultaneously combining reinforced concrete elements of a different type with insulation(waterproofing, protection from chemical corrosion, thermal insulation).

By 1990 a significant amount of work must be carried out in the automation, remote control, and centralized traffic control of the thermal networks of Moscow. The leading specialized scientific research and design institutes have been attracted to carrying out these things.

With today's tempo in the development of science and technology, it is difficult to predict 10-15 years ahead, and therefore the stated plans for the development of the Moscow centralized heating system will be continuously adjusted while they are being carried out.

In accordance with technological planning norms, the calculated temperature of the Moscow outside air was assumed to be -25 degrees C. During 40 years(from 1939 to 1979) the temperature of the outside air sank lower than the calculated six times. The last case of a sharp and sufficiently lengthy cold snap was in the winter of 1978-79 and showed the necessity of carrying out a series of additional measures to ward off serious disruptions to the heat supply.

Plans call for a review of the technological planning norms as they relate to providing a reserve TETS heating capacity, to increase the reliability of the electrical supply of TsTP/central heating point/ and ITP/expansion unknown/, and to increase the rated productivity of the chemical water purifier units for supplying the boiler water-level of the heating networks with chemically purified water in extreme situations.

With an intensive organic fuel balance and the forcing of construction in the 1981-1990 period of atomic condensation power stations in the European part of the Soviet Union, as well as with the introduction into operation during this period of distant electric power transmission lines from the Ekibastuzskiy power fuel complex, it will become fully possible to use an organic fuel TETS to cover the variable part of the electrical load schedule. The mobile possibilities of TETS equipment during a corresponding change of a heating circuit is higher than for condensation electric power stations.

During the operation of a TETS in accordance with the electrical schedule, its mobile possibilities are used first within the limits of the condensation generation of electric power.

An increase in the mobility of a TETS while operating according to a heating schedule is achieved by switching an ROU/pressure-reducing and cooling unit/ into the heating circuit of the TETS. The availability of an ROU permits the lowering of the electrical load of centralized heating system turbines because the decrease in the amount of back-pressure steam during the lowering of the electrical load is compensated by the reduced steam of the power boilers. Thus, the load of the power boilers, whose lowering depth is limited mainly by their technical load minimum, especially when operating on solid fuel, is lowered at a TETS significantly less than at condensation electric power stations.

With a view toward shortening the railroad transportation of fuel in the European part of the country, the question has been raised of creating large regional thermal stations in Moscow. In the given option of developing heat supply sources at the level of 1990 loads, the delivery of fuel to Moscow is being decreased by 4.4 million tons of conventional fuel per year. However, at the same time there will be a yearly over-expenditure of fuel in the national economy on the order of 2.5 million tons of conventional fuel because of the generation at condensation electric power stations of the amount of the electric power not fully received from the TETS.

Only a thorough analysis with other sectors of the national economy by appropriate technical and economic calculations of the totality can give a true answer.

A great deal of scientific research and design work is being conducted by architectural construction institutes and the public utility institutes of the large cities of the country which is aimed at the maximum decrease of fuel and electric power losses.

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